

REQUIRED MATERIALS FOR DIGITIZING PROBE ASSEMBLY

- (1) SLIDING CLOSET DOOR SPRING
- (1) 1/2" OD ALUMINUM TUBE (LOWES)
- (1) PNEUMATIC NEEDLE BALL INFLATION TIP
- (1) PIN WITH A BALL HEAD
- (3) 1/4"-20 X 2.5" HEX BOLTS
- (3) 1/4"-20 HEX NUTS
- 14 GAUGE SOLID COPPER WIRE
- 22 GAUGE HOOKUP WIRE
- SOLDER
- SUPER GLUE
- 1/16" CHIP BOARD
- 1/2" MDF

3D DIGITIZER

I wanted to design a digitizing probe for my CNC that could take advantage of the simple digitizer application that is included in Mach3. The concept of a digitizer is very simple. Instead of giving your CNC coordinates and having the machine blindly go to them, you give the machine a grid to feel around, when it 'feels' something, Mach3 records this point and writes it to a file.

A simple way to add the sense of touch to your machine is to provide a circuit that is continuous until it bumps into something. When the circuit is broken, Mach3 records the coordinates. The more complex problem to solve is that the tip of the digitizer may interface with the digitized object at any kind of slope, so the circuit needs to be broken when touched at any angle.

To achieve this, I designed a sort of celtic switch that if any of the six points loose contact, the circuit is broken. Once I had the simple design below, everything else was just figuring out how to hold it all together.

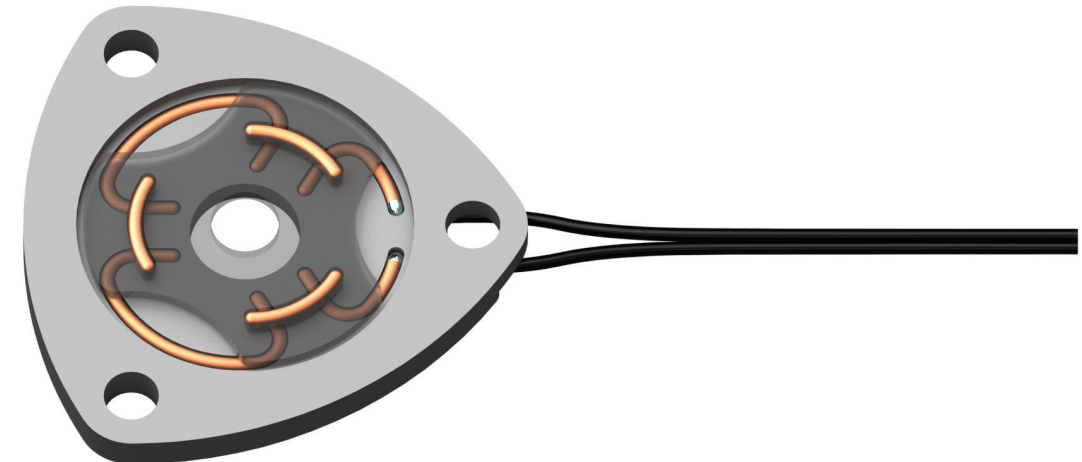
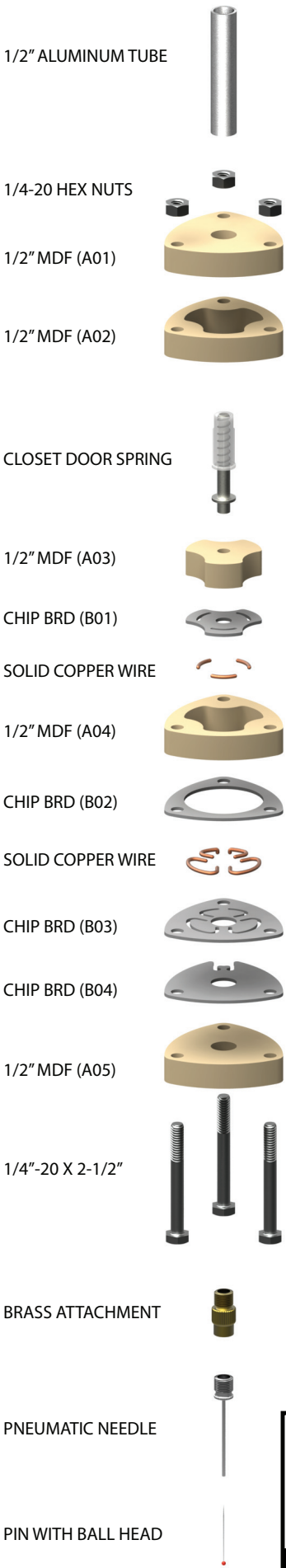
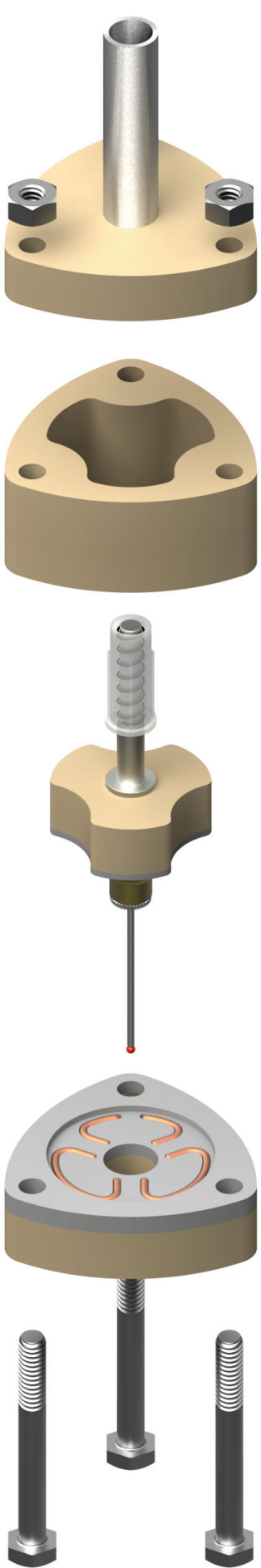
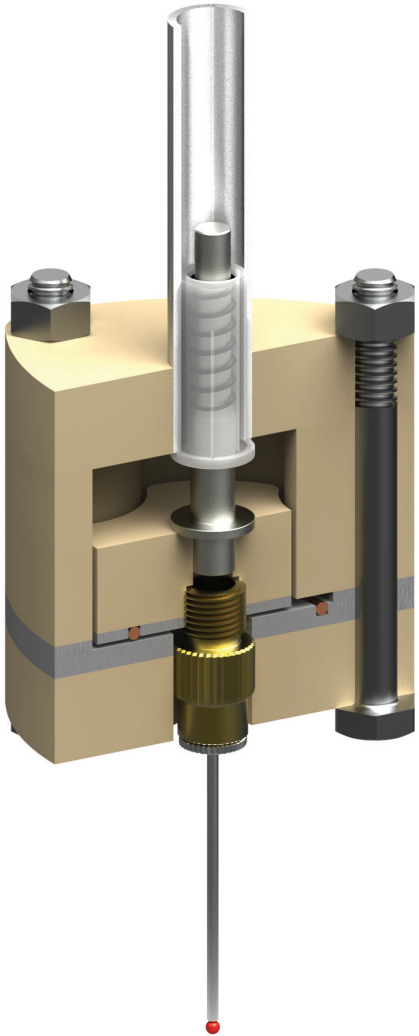
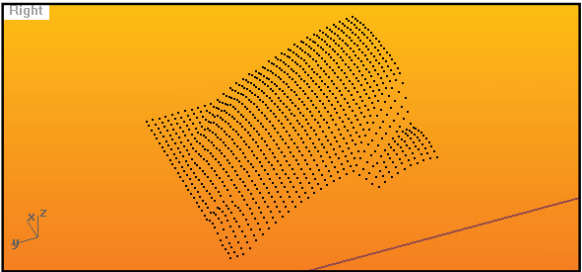
I used the same 1/2" OD aluminum tube that I did for the pen holder that fits perfectly into the collet of my router (always being sure to unplug the power). Glue a tube approximately 2.5" long into the top layer of MDF. When I built my digitizer, I had the benefit of being able to use a laser cutter to cut the 'smart' components. For this document, I substitute a piece of 1/2" MDF in place of 8 layers of chip board that really have no consequence on function so that it is easy to CNC cut.

To hold the circuit together when it is not touching anything, I used a sliding closet door spring as it just happens to fit perfectly into the aluminum tube with very little modification.

The solid copper wire was sourced from a piece of common house wire (ROMEX). When bending these pieces, try to only touch the sides with needle nose pliers and make sure the wire is perfectly flat. Glue them in place, making sure to not leave any glue on the mating surfaces of the circuit. Solder your hookup wire onto the ends of the circuit. These wires should be long enough to reach from the CNC head to your controller.

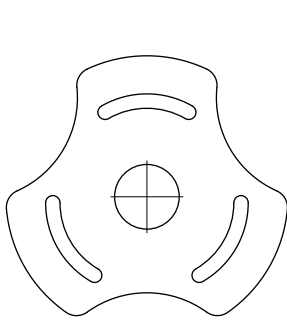
The other thing to solve was what to use for the digitizing needle. I decided to use a pneumatic basketball inflation needle with a ball head pin glued in the tip. At Harbor Freight, I found the pneumatic tip in a pack that also included the brass fitting shown in the renderings. I used this fitting to help extend the reach of the digitizer. If there was a longer needle, this part would not be necessary.

Once all of the components are assembled, you simply bolt together the body, compressing the internal spring. Now you just need to introduce Mach3 to your new digitizer!

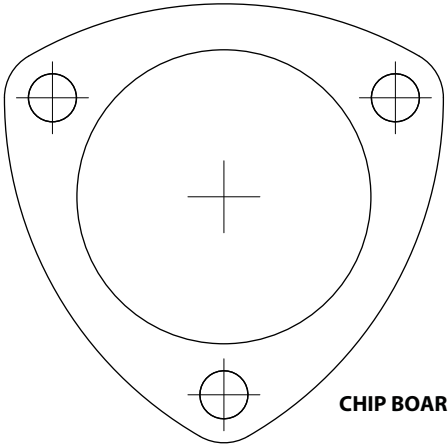


PATTERNS FOR DIGITIZING PROBE

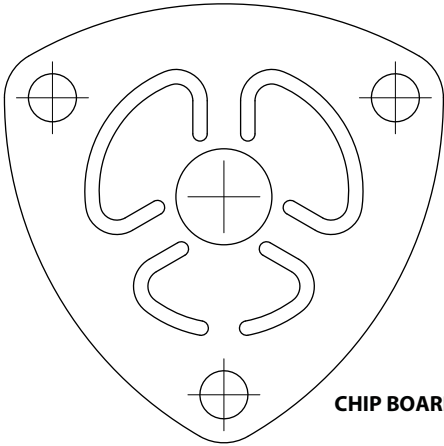
These are the patterns for the MDF and 1/16" chip board parts to build the digitizer. These represent the basic geometry at work inside of the digitizer. The CAD versions of these parts will be available at <http://www.grunblau.com/downloads/bmo.htm> for those who wish to CNC these parts.



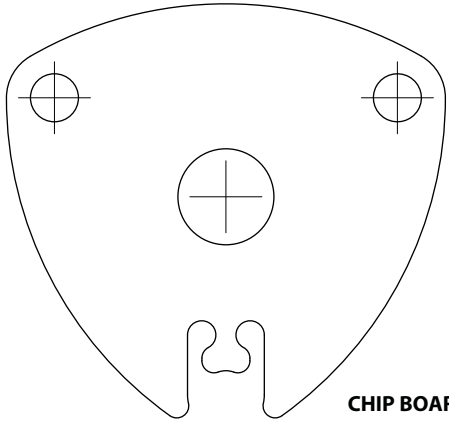
CHIP BOARD B01



CHIP BOARD B02



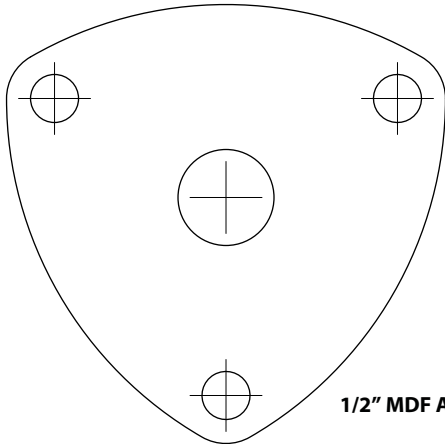
CHIP BOARD B03



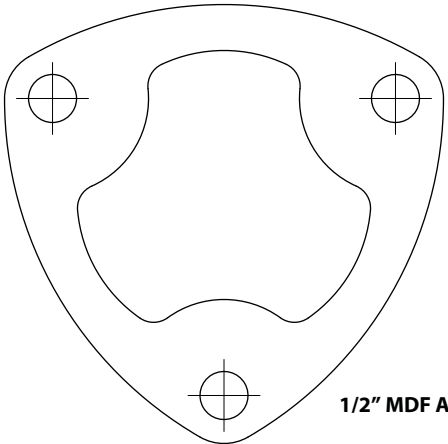
CHIP BOARD B04

This box should measure 1.5" X 1.5"

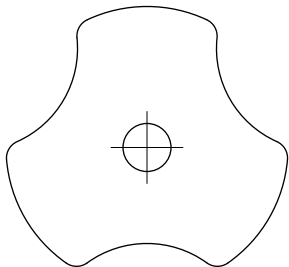
Print this document 1:1 on 11" X 17" paper. Do not scale to fit.



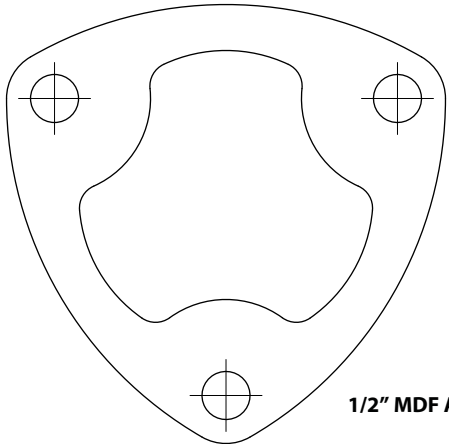
1/2" MDF A01



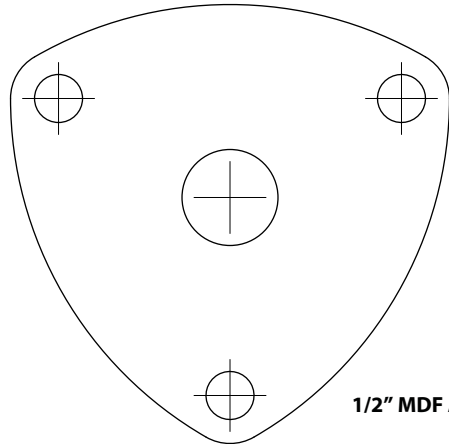
1/2" MDF A02



1/2" MDF A03



1/2" MDF A04

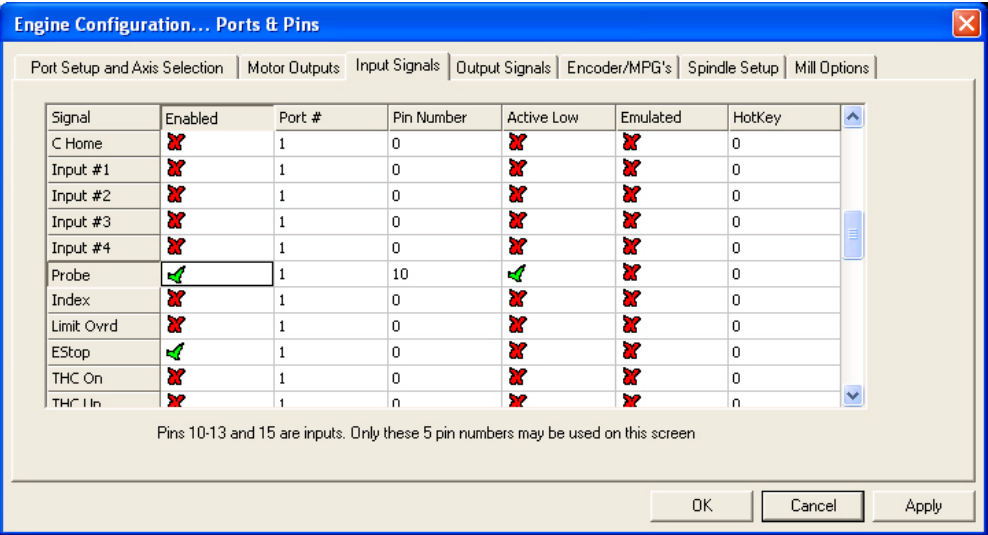


1/2" MDF A05

HARDWARE AND SOFTWARE SETUP

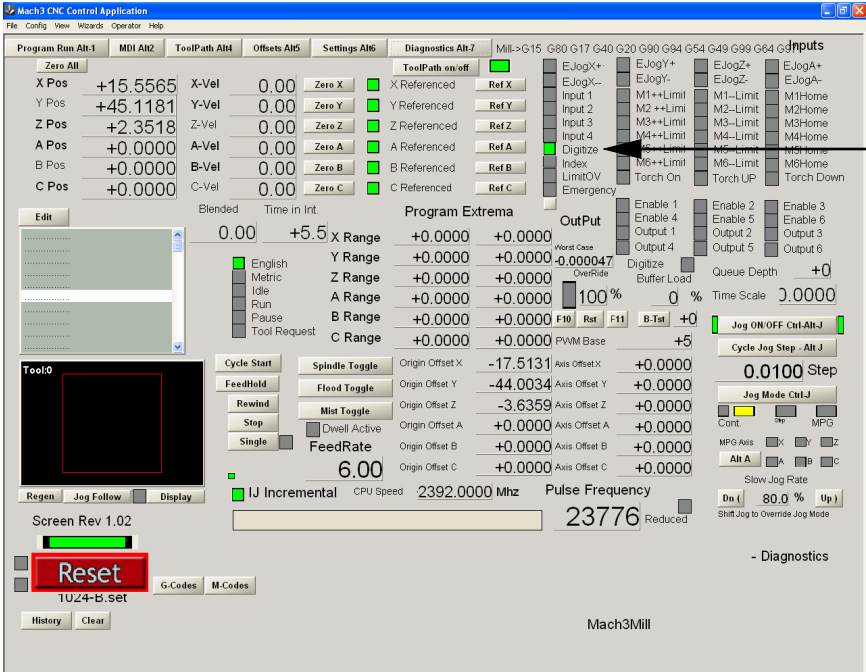
You will hook one of your wires up to Pin # 10 (or any other open pin on your breakout board) and the other wire to the GND.

SCALE: ACTUAL SIZE



PORTS AND PINS

Navigate to Config > Port & Pins > Inputs tab and pan down on the menu until you see the Probe signal. Check Enable and set the Port to #1 and the pin to 10 (or alternate pin #) and check Active Low. Click OK.



INTERFACING WITH MACH3

When properly setup, you can go to the Diagnostics tab in Mach3 and check to see if your digitizing probe is properly configured. When you touch the tip of the probe, you should see this indicator turn on, when you let go, it should turn off.

Go to > Wizards > Pick Wizard... > Digitizing. This will bring up a dialogue box that will ask you for the following inputs:

- Width (x) of digitizing area: +0.0" < This is the size of the part in the X axis from zero
- Height (y) of digitizing area: +0.0" < This is the size of the part in the Y axis from zero
- Z axis travel height: +0.0" < This is the safe travel height for the probe from zero
- Z axis Probe Depth +0.0" < This is how high to probe down to from zero
- X Stepover +0.0" < This is the resolution of the points probed in X axis
- Y Stepover +0.0" < This is the resolution of the points probed in Y axis
- Feedrate +0.0 < This is how fast the machine moves

Make sure that you do not set a feedrate that is too fast. You want your CNC to be able to have time to decelerate once it touches something. After setting the desired parameters, click create and load g-code. Zero your machine. A good first test is to run it in the air and manually touch the probe to make sure everything is working properly. Mach3 will save a text file with all of the points automatically. Depending on what software you are using, there are plugins available for importing the point cloud data.